

St. Joseph River
St. Joseph and Elkhart Counties
2006 Fish Management Report

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EXECUTIVE SUMMARY

- Smallmouth bass and rock bass data were collected at seven sites in July and August 2006 on the St. Joseph River, St Joseph and Elkhart Counties.
- When compared to past surveys, smallmouth bass catch rates declined at five of the seven sites sampled in 2006.
- The catch rates of rock bass increased at five of the seven sites compared to past surveys.
- While largemouth bass and walleye are less abundant than some game species, they are still providing good fishing opportunities for anglers.
- A diverse size range of smallmouth bass exist within the river, including several quality and memorable size fish.

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INTRODUCTION

The St. Joseph River originates in Hillsdale County, Michigan, and flows through Calhoun, Branch and St. Joseph Counties before entering Indiana. In Indiana the river flows through Elkhart and St. Joseph Counties, before reentering Michigan just north of South Bend, and eventually draining into Lake Michigan. The river drains approximately 2,600 square miles of southwestern Michigan and 1,685 square miles of north central Indiana (Ledet 1979). The Indiana portion of the watershed encompasses all of Lagrange and portions of Elkhart, Dekalb, Kosciusko, Noble, St. Joseph, and Steuben Counties. The St. Joseph River is considered navigable throughout Indiana for 39.57 river miles.

There is good public access available all along Indiana's portion of the St. Joseph River. There are twelve public accessible boat ramps located along the river, with all but four located in St. Joseph County. Due to the number of county parks, city parks, and state access sites, there is extensive shore access available to anglers as well. Bank fishing is prohibited by South Bend in portions of the city; however wading is not restricted.

There are twelve dams located on the river, four of which are located in Indiana; South Bend Dam, Mishawaka (Uniroyal) Dam, Twin Branch Dam, and Elkhart Dam. As expected, these dams have significantly altered the river's flow regime and habitat from its original state. The St. Joseph River has been host to introduced salmonids from Lake Michigan since the late 1960's. Beginning in 1977, plans were developed to construct four fish ladders, facilitating spawning runs of trout and salmon to migrate from Lake Michigan 63 miles upstream to Mishawaka, Indiana (Wesley and Duffy 1999). In 1992 construction of fish ladders at the South Bend and Mishawaka Dams were completed. Due to a combined effort by both Indiana and Michigan DNR, Indiana's portion of the St. Joseph River, up to Twin Branch Dam, receives annual spawning runs of steelhead trout, Chinook salmon, coho salmon, and brown trout.

Previous general fish surveys were conducted by the Indiana Department of Natural Resources in 1979 and 1989. Smaller surveys focusing on smallmouth bass were also conducted in 1982, 1985, and 1988. The objective of this survey was to evaluate the current smallmouth bass fishery and to assess any changes to the fishery following the introduction of trout and salmon in 1992.

METHODS

This survey of the St. Joseph River was conducted from July 5 to August 1, 2006 as part of DFW Work Plan 204027 that covers general fisheries surveys of rivers and streams. The timeframe for this survey was chosen based on historic sampling events, as well as the timing of the fall steelhead migration. Sampling sites were chosen based on previous surveys (Ledet 1979), and consisted of seven sites (sites 1,2,3,4,5,6, and 11; Figure 1, Appendix 1).

Dissolved oxygen, and pH were determined at each station using a Hach kit. Surface water temperature was measured using a thermometer.

Fish were collected at each site by pulsed D.C. electrofishing both shorelines in a general downstream direction with two dippers for a total of 1 hour (h) (30 minutes per shoreline). All fish collected were measured to the nearest 0.1 inches total length (TL) and weighed in the field to the nearest 0.01 lb.

Fish scale samples were taken from smallmouth bass, rock bass, largemouth bass, and walleye for age and growth analysis. Due to a low sample size of smallmouth bass and rock bass at certain sites, sites were combined based on location of dams for age and growth analysis. Combined sites included sites below South Bend dam (1, 2, and 3) and sites below Mishawaka dam (4 and 5). Due to an even lower sample size of largemouth bass and walleye, all sites were combined for analysis. Low sample size also prohibited the calculation of stock density indices at certain sites. Proportional stock density (PSD) and relative stock density (RSD) was calculated for smallmouth bass at sites 5, 6, and 11, while only PSD was calculated for rock bass at sites 2, 5, and 11 (Anderson and Neumann 1996).

RESULTS

Water Chemistry

During the survey period the temperature ranged from 72 to 79°F (Table 1). The dissolved oxygen content ranged from 8.0 to 10.0ppm, and the pH was consistently 7.5 at each site. The temperature ranges during past surveys in 1979 and 1989 were 61 to 66°F and 73 to 78°F, respectively (Ledet 1979 and 1990).

Fish Survey Data

A total of 511 fish, weighing 144.1 lbs were collected during this survey. Smallmouth bass were the most abundant species collected by number (50%), followed by rock bass (41%), largemouth bass (5%), and walleye (4%). Smallmouth bass were also the most abundant species collected by weight (46%), followed by rock bass (23%), walleye (20%), and largemouth (12%) (Table 2).

A total of 253 smallmouth bass weighing 75.2 lbs were collected during this survey (Table 2). Catch rates of smallmouth bass collected at each site ranged from 3 to 96 fish/h (Table 3). Site 5 exhibited the greatest catch rate, followed by site 11 (89 fish/h). The lowest catch rate was collected at site 4, followed by site 1 (7 fish/h). Catch rates of smallmouth bass during past surveys have ranged from 11 to 393 fish/h (Ledet 1990). Smallmouth bass ranged in length from 1.7 to 17.8 inches. Calculated PSD indices ranged from 30 to 71, while RSD-P ranged from 6 to 9 (Table 4). The largest percentage of fish greater than 12 inches was collected at site 1 (43%). No smallmouth bass greater than 12 inches were collected at site 4. Age-length keys indicated that smallmouth bass reach 12 inches at age 3 or age 4 (Appendix 2).

A total of 209 rock bass were collected during this survey (Table 2). Rock bass catch rates ranged from 2 to 75 fish/h. The greatest catch rate was collected at site 5, while site 3 exhibited the lowest catch rate. Catch rates of rock bass during past surveys ranged from 0 to 27 fish/h (Ledet 1979, 1985, 1989, and 1990). The length of rock bass during this survey ranged from 2.3 to 8.5 inches. Site 6 demonstrated the greatest percentage of rock bass greater than or equal to 7 inches (60%), followed by site 3 (50%) (Table 5). Calculated PSD indices ranged from 19 to 33 (Table 4). Age-length keys indicated that rock bass reach 7 inches at age 3 or age 4 (Appendix 3).

During this survey largemouth bass and walleye were collected in low numbers. The greatest number of largemouth bass were collected at site 6 (8), while the fewest were collected at sites 3 and 4 (1). Largemouth bass ranged in size from 4.3 to 16.5 inches. Walleye were collected at four of the seven sites sampled. The greatest number of walleye were collected at site 5 (9). Three of the four age-1 walleye sampled were collected at site 5. Walleye ranged in size from 10.8 to 23.1 inches (Table 2).

DISCUSSION

Although smallmouth bass catch rates declined when compared to past surveys, the St. Joseph River continues to support a quality smallmouth bass fishery. When compared to past surveys, catch rates declined at five of the seven sites sampled in 2006 (Table 3). Only sites 6 and 11 demonstrated increases in catch rates from some past studies. While site 11 exhibited the second highest catch rate ever recorded for that site, 85% of the bass were age 1 (4.1 - 7.1 in). The catch rate at site 6 was higher than the previous survey in 1989; however it was still lower than the catch rate observed at that site in 1979. Differences in catch rates from single samples can often be variable; however there are other possible reasons behind the decline. Much of the decline in catch rates compared to past surveys can be attributed to differences in time of sampling and water temperatures. Due to spawning activities smallmouth bass may be more vulnerable to sampling during the month of June, and the best catch rates generally occur when water temperatures are in the mid 60's (Ledet 1990). However, the time of sampling and water temperature during the 1989 and present survey were very similar, while catch rates for smallmouth were generally lower.

The introduction of trout and salmon, primarily steelhead, into Indiana portions of the river could also be responsible for the decline in smallmouth catch rates. Site 11 was one of only two sites that demonstrated an increase in smallmouth bass catch rate from past studies. Site 11 also happens to be the only site sampled that is excluded from the section of river open to salmonid migrations. Steelhead predation on juvenile bass, along with competition for food and overwintering habitat could be detrimental to smallmouth abundance. However, the most likely cause behind the decline in smallmouth bass is increased development and water quality impacts within the watershed. The increase of impervious surfaces as well as the removal of riparian vegetation can have serious impacts to fish communities. Impervious surfaces increase runoff and erosion, which in turn increases sediment loading into streams and rivers within the watershed. Riparian vegetation, including trees and woody debris, provides valuable habitat and shade for many species including the smallmouth bass (Angermeier and Karr 1984, Lobb III and Orth 1991). As more development continues along the river and elsewhere within the watershed, a certain degree of decline in the fish community can be expected.

Due to the length of time between surveys, it is difficult to compare current growth to past surveys. However it does appear that growth of smallmouth bass has remained similar when compared to past surveys (Ledet 1979, 1985, 1989, and 1990). Smallmouth bass continue to reach harvestable size at age 3 or age 4 (Appendix 2).

The number of year classes present (5), and the size range of smallmouth bass collected during this survey remains similar to past surveys. A diverse size range of fish exists within the river, including several quality and memorable size fish. While most of the year classes appeared strong, the 2004 year class was underrepresented. This could be explained by the higher than normal discharge during June of 2004 (United States Geological Survey, 2006). Stefanavage (1990) demonstrated a negative relationship between smallmouth bass year class strength and high river discharge during the spawning season.

While smallmouth bass catch rates declined compared to past surveys, the catch rates of rock bass did the opposite. The catch rates of rock bass increased at five of the seven sites compared to past surveys (Table 4). The 2003 year class comprised the bulk of the catch at most sites, and should provide quality fishing opportunity in the next couple of years. Again, due to the length of time between surveys, it is difficult to compare current growth. However, it does appear that growth of rock bass has remained similar when compared to past surveys (Ledet 1979, 1989, and 1990). Rock bass continue to reach quality size at age 3 or age 4 (Appendix 3).

While largemouth bass and walleye are less abundant than smallmouth and rock bass, they are still providing good fishing opportunities for anglers. Although the catch rates of largemouth bass were low, 32% of the fish sampled were of harvestable size. Largemouth bass typically prefer standing water and are more abundant in the impoundments. Walleye appeared to be more abundant below dams, with all but one individual collected at sites directly downstream of a dam. Of the twenty-one walleye collected, 71% (15) were of harvestable size, 15 in (Appendix 5). While no walleye were stocked into Indiana waters of the St. Joseph River in 2005, four age-1 individuals were collected. These fish could be the result of natural reproduction, or a result of downstream drift from upstream stockings conducted by the Michigan DNR.

RECOMMENDATIONS

- The DFW should maintain the 12-inch minimum size limit on black bass in the St. Joseph River.
- The DFW should conduct a complete general survey of the St. Joseph River within the next few years to update information about the river's native fish population.
- Fish sampling should be conducted at site 5 upon completion of the Mishawaka river walk to evaluate the impacts of the removal of riparian vegetation and shoreline habitat.
- Continued effort should be given to protecting the riparian habitat and woody debris along the St. Joseph River. Development along the shorelines of the river eliminates valuable habitat for several native fish species as well as steelhead smolts.

LITERATURE CITED

- Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-481 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.
- Angermeier, P. L., and J. R. Karr. 1984. Relationships between woody debris and fish habitat in a small warmwater stream. Transactions of the American Fisheries Society. 113:716-726.
- Wesley, J.K. and J.E. Duffy. 1999. St. Joseph River Assessment. Michigan Department of Natural Resources, Fisheries Division, Special Report 24, Ann Arbor, Michigan.
- Ledet, N.D. 1979. A fisheries survey of the St. Joseph River in St. Joseph and Elkhart counties, Indiana Department of Natural Resources, Indianapolis. 40 pp.
- Ledet, N.D. 1985. St. Joseph River spot check survey, Indiana Department of Natural Resources, Indianapolis. 15 pp.
- Ledet, N.D. 1989. St. Joseph River smallmouth bass, Indiana Department of Natural Resources, Indianapolis. 5 pp.
- Ledet, N.D. 1990. St. Joseph River fish population survey, Indiana Department of Natural Resources, Indianapolis. 20 pp.
- Lobb III, M.D. and D. J. Orth. 1991. Habitat use by an assemblage of fish in a large warmwater stream. Transactions of the American Fisheries Society. 102:65-78.
- Stefanavage, T.C. 1990. Evaluation of smallmouth bass year class strength and population size at three northern Indiana rivers, Indiana Department of Natural Resources, Indianapolis. 13 pp.
- United States Geological Survey. 2006. USGS real-time water data for Indiana. United States Geological Survey. Available: <http://waterdata.usgs.gov/in/nwis/rt>. (November 2006).

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**St. Joseph River Historical Fish
Sampling Sites 1-6 and 11 from 2006 (Ledet 1979)**

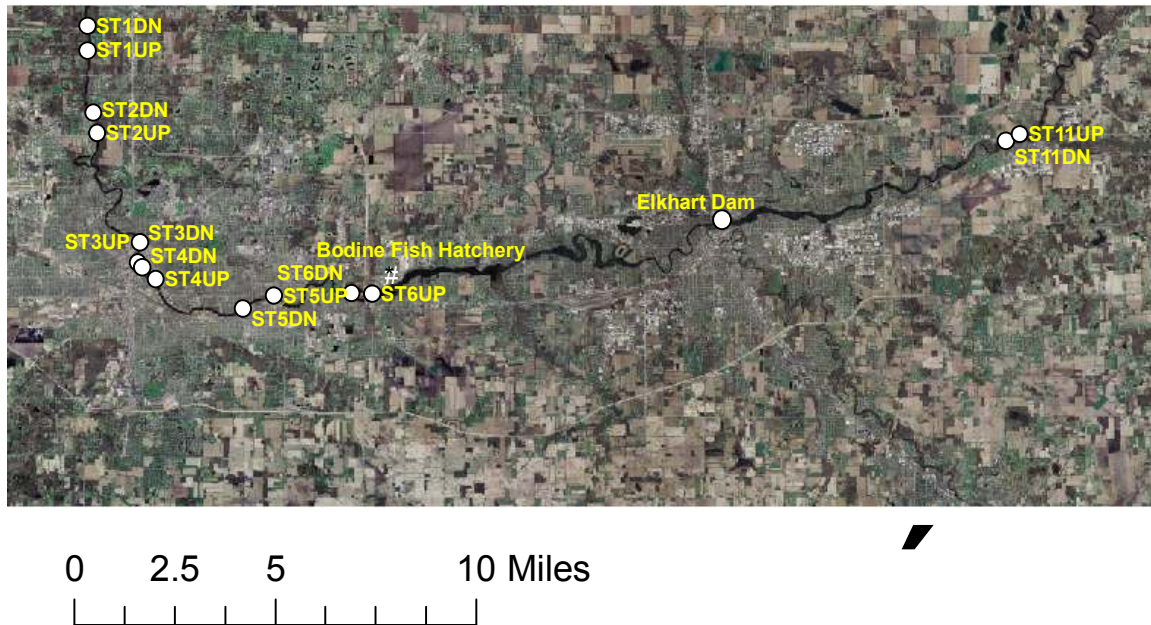


Figure 1. Upstream and downstream locations of St. Joseph River historical sampling sites.

Table 1. Water temperature, dissolved oxygen, and pH collected at fish sampling locations on the St. Joseph River.

Site	Date	Water Temperature (°F)	D.O. (ppm)	pH
1	7/5/2006	72	10.0	7.5
2	7/5/2006	73	9.0	7.5
3	8/1/2006	79	8.0	7.5
4	7/10/2006	76	9.5	7.5
5	7/27/2006	76	8.0	7.5
6	7/10/2006	76	9.0	7.5
11	7/14/2006	75	8.0	7.5

Table 2. Species and relative abundance of fish collected by number and weight on the St. Joseph River, 2006.

Common Name of Species	Number	Percent	Length Range (in)	Weight (lbs)	Percent
Smallmouth Bass	253	50	1.7 - 17.8	75.2	46
Rock Bass	209	41	2.3 - 8.5	37.3	23
Largemouth Bass	28	5	4.3 - 16.5	19.9	12
Walleye	21	4	10.8 - 23.1	32.6	20
Total	511			165.0	

Table 3. Sample site, date sampled, catch per unit effort (CPUE), sampling effort, length range, and percent of harvestable size smallmouth bass collected on the St. Joseph River from 1979 through 2006.

Sample Site	Sample Year	Month Sampled	CPUE	Sampling Effort (h)	Smallest Fish (in)	Largest Fish (in)	% ≥ 12 inches
1	1979	July	40	1.25	3.3	15.6	8.0
	1989	July	17	1.0	4.6	15.0	17.6
	2006	July	7	1.0	4.7	15.3	42.9
2	1979	June	45	1.25	3.6	14.1	10.7
	1982	August	77	1.0	NA	NA	NA
	1985	June	105	1.0	3.9	14.5	1.9
	1988	June	74	1.0	3.4	13.3	5.4
	2006	July	21	1.0	4.5	16.5	4.8
3	1979	June	97	1.25	3.4	16.9	5.0
	1989	July	48	1.0	4.6	17.2	22.9
	2006	August	12	1.0	4.2	13.5	16.7
4	1979	June	63	1.25	3.2	12.1	6.3
	2006	July	3	1.0	7.8	11.0	0.0
5	1979	June	207	1.25	3.6	14.9	1.2
	1985	June	103	1.0	4.3	15.5	6.8
	1988	June	393	1.0	3.3	18.1	8.1
	1989	July	105	1.0	4.0	17.7	3.8
	2006	July	96	1.0	1.7	17.8	10.4
6	1979	June	41	1.25	3.9	13.9	3.9
	1989	July	11	1.0	6.6	14.7	9.1
	2006	July	25	1.0	4.3	17.7	20.0
11	1979	August	50	1.25	2.3	16.5	3.2
	1982	August	137	0.67	NA	NA	NA
	1985	August	56	1.0	3.7	13.9	5.4
	1988	June	76	1.0	3.7	14.6	11.8
	1989	July	28	1.0	4.1	11.8	3.6
	2006	July	89	1.0	4.1	17.7	2.2

Table 4. Proportional stock density (PSD) and relative stock density-preferred (RSD-P) of smallmouth bass collected at sites 5,6, and 11, and of rock bass collected at sites 2,5, and 11 on the St. Joseph River, 2006.

smallmouth bass		
Sample Site	PSD	RSD-P
5	30	9
6	71	7
11	33	6
rock bass		
2	19	-
5	33	-
11	28	-

Table 5. Sample site, date sampled, catch per unit effort (CPUE), sampling effort, length range, and percent of rock bass greater than or equal to 7 inches collected on the St. Joseph River from 1979 through 2006.

Sample Site	Sample Year	Month Sampled	CPUE	Sampling Effort (h)	Smallest Fish (in)	Largest Fish (in)	% ≥ 7 inches
1	1979	July	19	1.25	4.2	9.1	NA
	1989	July	5	1.0	4.6	7.6	NA
	2006	July	23	1.0	2.5	8.0	21.7
2	1979	June	2	1.25	5.7	5.8	NA
	1985	June	21	1.0	4.3	9.2	NA
	1988	June	12	1.0	4.9	9.5	58.3
	2006	July	31	1.0	2.3	8.3	12.9
3	1979	June	0	1.25	NA	NA	NA
	1989	July	14	1.0	5.9	9.4	NA
	2006	July	2	1.0	6.7	7.5	50.0
4	1979	June	13	1.25	2.3	8.6	NA
	2006	July	11	1.0	5.1	7.0	9.1
5	1979	June	11	1.25	3.6	6.7	NA
	1985	June	1	1.0	5.3	5.3	NA
	1989	July	9	1.0	3.5	8.0	NA
	2006	July	75	1.0	2.8	8.1	26.7
6	1979	June	4	1.25	4.1	8.9	NA
	1989	July	4	1.0	3.3	8.5	NA
	2006	July	20	1.0	5.7	8.5	60.0
11	1979	August	2	1.25	3.4	7.1	NA
	1985	August	9	1.0	4.1	8.7	NA
	1988	June	27	1.0	4.3	9.5	55.6
	1989	July	9	1.0	5.7	9.1	NA
	2006	July	47	1.0	3.9	8.3	27.7

Appendix 1

Locations of fish sampling sites on the St. Joseph River.

Locations of fish sampling sites on the St. Joseph River, 2006

Site	Location	Latitude	Longitude
1	Downstream	41.761812	-86.272012
1	Upstream	41.753063	-86.271956
2	Downstream	41.730688	-86.269039
2	Upstream	41.723345	-86.267113
3	Downstream	41.684193	-86.246245
3	Upstream	41.676972	-86.247013
4	Downstream	41.675280	-86.245029
4	Upstream	41.671014	-86.238363
5	Downstream	41.660717	-86.196300
5	Upstream	41.665233	-86.181417
6	Downstream	41.666373	-86.143939
6	Upstream	41.666233	-86.134067
11	Downstream	41.722025	-85.829038
11	Upstream	41.724398	-85.822242

Appendix 2

Age-length keys and mean lengths-at-age for smallmouth bass.

Age-length key for smallmouth bass captured at sites 1,2, and 3 on the St. Joseph River in July(sites 1 and 2) and August (site 3) 2006.

Length Group	# in sample	# (age) in subsample	Age				
			1	2	3	4	5
4.0	1	1(1)	1				
4.5	5	5(1)	5				
5.0	7	5(1)	7				
5.5	5	5(1)	5				
6.0	4	3(1), 1(2)	3	1			
6.5	2	1(1), 1(2)	1	1			
7.0	4	4(1)	4				
7.5							
8.0							
8.5							
9.0	1	1(3)			1		
9.5	3	2(3)			3		
10.0							
10.5	1						
11.0	1	1(4)				1	
11.5							
12.0							
12.5	1						
13.0							
13.5	1	1(5)					1
14.0							
14.5							
15.0	3	2(5)					3
15.5							
16.0							
16.5	1						
Mean TL			5.7	6.5	9.6	11.3	14.9
SE			0.17	0.25	0.13		0.38

Age-length key for smallmouth bass captured at sites 4 and 5 on the St. Joseph River in July 2006.

Length Group	# in sample	# (age) in subsample	Age				
			1	2	3	4	5
1.5	1						
2.0							
2.5	1						
3.0							
3.5	2	1(1)	2				
4.0	2						
4.5	10	6(1)	10				
5.0	7	3(1)	7				
5.5	11	5(1)	11				
6.0	12	3(1), 1(2)	9	3			
6.5	7	4(1)	7				
7.0	7	6(1)	7				
7.5	5	3(1), 1(2)	4	1			
8.0	5	3(1), 2(2)	3	2			
8.5	1	1(3)			1		
9.0	4	2(2), 2(3)		2	2		
9.5	1	1(4)				1	
10.0	6	5(3)			6		
10.5	3	1(3), 2(4)			1	2	
11.0	4	2(3), 1(4)			3	1	
11.5							
12.0	1						
12.5	2	2(4)				2	
13.0	2	2(3)			2		
13.5	1	1(3)			1		
14.0	1	1(4)				1	
14.5	1						
15.0							
15.5	1	1(5)					1
16.0							
16.5							
17.0							
17.5	1						
Mean TL			6.1	7.7	10.8	11.7	15.8
SE			0.14	0.44	0.37	0.56	

Age-length key for smallmouth bass captured at site 6 on the St. Joseph River in July 2006.

Length Group	# in sample	# (age) in subsample	Age				
			1	2	3	4	5
4.0	3	3(1)	3				
4.5	1	1(1)	1				
5.0							
5.5	2	2(1)	2				
6.0	1	1(1)	1				
6.5	4	4(1)	4				
7.0	2	2(1)	2				
7.5							
8.0							
8.5							
9.0							
9.5							
10.0	1	1(3)			1		
10.5	1	1(3)			1		
11.0	2	2(4)				2	
11.5	3	3(3)			3		
12.0	1	1(4)				1	
12.5	2	1(3), 1(4)			1	1	
13.0	1						
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5	1	1(5)					1
Mean TL			5.9		11.5	11.9	17.8
SE			0.32		0.36	0.38	

Age-length key for smallmouth bass captured at site 11 on the St. Joseph River in July 2006.

Length Group	# in sample	# (age) in subsample	Age				
			1	2	3	4	5
4.0	6	4(1)	6				
4.5	15	5(1)	15				
5.0	16	5(1)	16				
5.5	16	5(1)	16				
6.0	10	4(1)	10				
6.5	8	5(1)	8				
7.0	5	5(1)	5				
7.5	1	1(2)		1			
8.0							
8.5	3	3(2)		3			
9.0	2	1(2), 1(3)		1	1		
9.5							
10.0							
10.5	1	1(3)			1		
11.0	1	1(3)			1		
11.5	3	1(2), 1(3), 1(4)		1	1	1	
12.0	1	1(3)			1		
12.5							
13.0							
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5	1	1(5)					1
Mean TL			5.6	9.2	11.1	11.8	17.8
SE			0.10	0.55	0.51		

Appendix 3

Age-length keys and mean lengths-at-age for rock bass.

Age-length key for rock bass captured at sites 1,2, and 3 on the St. Joseph River in July(sites 1and 2) and August (site 3) 2006.

Length Group	# in sample	# (age) in subsample	Age				
			1	2	3	4	5
2.0	1						
2.5	7	4(1)	7				
3.0	6	5(1)	6				
3.5	3	3(1)	3				
4.0	1	1(1)	1				
4.5	3	1(1), 2(2)	1	2			
5.0	5	4(2)		5			
5.5	5	3(3)			5		
6.0	10	6(3)			10		
6.5	5	4(3)			5		
7.0	3	2(3), 1(4)			2	1	
7.5	5	5(4)				5	
8.0	2	2(5)					2
Mean TL			3.3	5.1	6.3	7.7	8.3
SE			0.14	0.09	0.10	0.08	0.00

Age-length key for rock bass captured at sites 4 and 5 on the St. Joseph River in July 2006.

Length Group	# in sample	# (age) in subsample	Age			
			1	2	3	4
2.5	2					
3.0	6	5(1)	6			
3.5	6	3(1)	6			
4.0	4	1(2)		4		
4.5	1	1(2)		1		
5.0*	5	2(2),2(3)		3	3	
5.5	11	2(2), 3(3)		4	7	
6.0	17	5(3)			17	
6.5	13	5(3)			13	
7.0	13	4(3)			13	
7.5*	5	2(3), 2(4)			3	3
8.0	3	2(4)				3
Mean TL			3.5	5.1	6.6	8.0
SE			0.08	0.19	0.08	0.12

* Due to an odd numbered sample size, there is actually 2.5 fish represented for each age class.

Age-length key for rock bass captured at site 6 on the St. Joseph River in July 2006.

Length Group	# in sample	# (age) in subsample	Age			
			1	2	3	4
5.5	2	2(3)			2	
6.0	1	1(3)			1	
6.5	5	4(3)			5	
7.0	9	3(2), 2(4)			5	4
7.5	2	1(4)				2
8.0						
8.5	1	1(4)				1
Mean TL					6.8	7.6
SE					0.15	0.22

Age-length key for rock bass captured at site 11 on the St. Joseph River in July 2006.

Length Group	# in sample	# (age) in subsample	Age			
			1	2	3	4
3.5	1	1(2)		1		
4.0	10	4(2)		10		
4.5	12	3(2), 2(3)		7	5	
5.0	2	1(2), 1(3)		1	1	
5.5	1	1(3)			1	
6.0	3	1(3)			3	
6.5	5	3(3), 2(4)			3	2
7.0	8	4(3), 1(4)			6	2
7.5	2	2(4)				2
8.0	3	3(4)				3
Mean TL				4.5	6.2	7.6
SE				0.08	0.23	0.21

Appendix 4

Age-length keys and mean lengths-at-age for largemouth bass and walleye.

Age-length key for largemouth bass captured at sites 1-6 and 11 on the St. Joseph River in 2006.

Length Group	# in sample	# (age) in subsample	Age					
			1	2	3	4	5	6
4.0	1	1(1)	1					
4.5								
5.0	2	1(1), 1(2)	1	1				
5.5	2	2(1)	2					
6.0	4	2(1)	4					
6.5								
7.0*	5	2(1), 2(2)	3	3				
7.5	2	2(2)		2				
8.0	2	1(1), 1(2)	1	1				
8.5								
9.0								
9.5								
10.0								
10.5								
11.0								
11.5	1	1(3)			1			
12.0								
12.5								
13.0								
13.5	3	1(3), 2(4)			1	2		
14.0	1	1(5)					1	
14.5	1	1(4)				1		
15.0	1	1(5)					1	
15.5	1	1(5)					1	
16.0	1	1(5)					1	
16.5	1	1(6)						1
Mean TL			6.3	7.3	12.8	14.1	15.4	16.8
SE			0.31	0.39	1.00	0.33	0.43	

* Due to an odd numbered sample size, there is actually 2.5 fish represented for each age class.

Age-length key for walleye captured at sites 1-6 and 11 on the St. Joseph River in 2006.

Length Group	# in sample	# (age) in subsample	Age				
			1	2	3	4	5
10.5	2	2(1)	2				
11.0	1	1(1)	1				
11.5	1	1(1)	1				
12.0							
12.5							
13.0							
13.5							
14.0							
14.5	2	2(2)		2			
15.0	1	1(2)		1			
15.5	4	4(2)		4			
16.0	1	1(2)		1			
16.5	1	1(3)			1		
17.0	1	1(3)			1		
17.5	3	1(3), 2(4)			1	2	
18.0	1	1(4)				1	
18.5							
19.0	1	1(5)					1
19.5							
20.0							
20.5							
21.0							
21.5							
22.0	1	1(5)					1
22.5							
23.0	1	1(5)					1
Mean TL			11.1	15.5	17.3	17.9	21.6
SE			0.24	0.19	0.29	0.17	1.20